USC § 102 (e); and rejected claims 11-13 under 35 USC § 103. In rejecting the claims, U.S. Patent Application Publications 2001/0050802 to Namiki et al. and 2002/0075560 to Foursa, and U.S. Patent 6,433,921 to WU et at. (References A, C and B, respectively) were cited. Claims 4, 5, 11-13, 15 and 16 remain in the case. The Examiner's rejections are traversed below.

The Invention

The present invention is directed to an optical transmission system having a bi-directional transmission line, including first and second optical transmission lines, with Raman amplifiers positioned on the bi-directional transmission line. Each of the Raman amplifiers use a plurality of pump lights to amplify optical signals on both of the first and second optical transmission lines. When one of the optical terminal stations determines that the power of a first pump light in a first Raman amplifier has dropped to or below a predetermined level, the power of at least one pump light is increased. In a first embodiment, a pump light having the same or nearly the same wavelength as the first pump light is selected, in each of two Raman amplifiers on either side of the first Raman amplifier, to have its power increased. In a second embodiment, the power of a second pump light in the first Raman amplifier is increased. The second pump light selected to have its power increased has a wavelength adjacent to the wavelength of the first pump light. In both embodiments, the first and second optical transmission lines in the vicinity of the first Raman amplifier continue to be supplied with the same power level of pump light as do the first and second optical transmission lines along the rest of the bi-directional transmission line.

The Prior Art

U.S. Patent Appl. Publ. 2001/0050802 to Namiki et al.

The Namiki et al. patent application publication is directed to a Raman amplifier system for a single optical fiber to amplify signal transmission in one direction. A control unit 4 (Fig. 3) in a Raman amplifier monitors performance and adjusts amplification performance to maintain target values. Based on information received from other amplifiers 32, 34 via network 3000 or remote device controller 4000, controller 4 maintains overall system performance.

U.S. Patent Appl. Publ. 2002/0075560 to Foursa

The Foursa patent application publication is directed to a method and apparatus for reducing polarization dependent gain in Raman amplification for apparently unidirectional signal transmission in multiple transmission fibers.

U.S. Patent 6,433,921 to Wu et al.

The Wu et al. patent is directed to multiwavelength pumps for Raman amplifier systems 18 (Fig. 2) whose operation is controlled by control unit 23. The Raman pump 20 includes a monitor 78 having detectors 80 on the back facet 74 of semiconductor device 62 that are aligned with waveguides 64 to detect the strength of each wavelength input to optical multiplexer 68. No description has been cited or found of any connection of monitors 78 to another device; however, column 8 describes an optical channel monitor 54 (Fig. 4) that measures the power of optical signals obtained from taps 48 and 50 on either side of gain stage 46 and control unit 23 is described as controlling "the pump powers produced at each of the multiple pump wavelengths provided by Raman pump 20 or Raman pumps 20 in stage 46 based on the information provided by optical channel monitor 54" (column 8, lines 27-31). In addition, control unit 23 may include communications circuitry for communicating with network equipment" (column 6, lines 54-55) which "may send commands to control unit 23 that direct amplifier 18 to establish a particular gain setting or output power setting" (column 7, lines 1-3). The information gathered by control unit 23 "on the pump powers produced at the different pump wavelengths in pump 20 ... may be provided to the network control and management system by the control unit over the communications link" (column 7, lines 8-12).

Drawings

In the second paragraph on page 2 of the Office Action, the Examiner required the addition of "a legend such as --Prior Art-- to Figs. 1-3". A Letter to the Examiner requesting approval of proposed changes to the drawings is submitted herewith indicating the required changes. Approval of these proposed changes and withdrawal of the objection to the drawings is respectfully requested.

Rejections under 35 USC § 112, Second Paragraph

In the Office Action, claims 13, 15 and 16 were rejected under the second paragraph of 35 USC § 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regard as their invention. Claims 13, 15 and 16 have been

amended in response to these rejections. Therefore, withdrawal of the rejections is respectively requested.

If any of the amended claims are believed to still be indefinite, the Examiner is respectfully requested to contact the undersigned by telephone to arrange an Examiner Interview for the purpose of finding claim language that is not indefinite.

Rejections under 35 USC § 102 (e)

On pages 4-5 of the Office Action, claims 4, 5 and 13 were rejected under 35 USC § 102(e) as anticipated by Namiki et al. Claims 4 and 5 have been amended to recite "a bi-directional transmission line including first and second optical transmission lines" (e.g., claim 4, lines 2-3). As discussed above and as recognized in the rejection of claims 11 and 12 only after adding the teachings of Foursa to those of Namiki et al., there is only a single optical fiber operated on by the Raman amplifier system taught by Namiki et al. As illustrated in, e.g., Figs. 4 and 5 of the application, an optical transmission system according to the present invention uses "a multi-optical fiber cable ... [in which] [s]ignals are bi-directionally transmitted between the terminal stations" (application, page 10, lines 22-24). Therefore, once -amended claims 4, 5 and 13 are not anticipated by Namiki et al.

Rejections under 35 USC § 103

On pages 5-6 of the Office Action, claims 11-13 were rejected under 35 USC § 103(a) as unpatentable over Namiki et al. in view of Foursa. Nothing has been found in Foursa suggesting application of Raman amplifier to a bi-directional transmission line as now recited in claim 4. Since claims 11-13 depend from claim 4, it is submitted that claims 11-13 patentability distinguish over Namiki et al. in view of Foursa.

On pages 6-7 of the Office Action, claims 15 and 16 were rejected under 35 USC § 103(a) as unpatentable over Namiki et al. in view of Wu et al. Nothing has been cited or found in Wu et al. suggesting any method for controlling a "Raman amplifier ... positioned on a bi-directional optical transmission line" as recited on line 2 of amended claims 15 and 16. Therefore, it is submitted that claims 15 and 16 patentable distinguish over the combination of Namiki et al. in view of Wu et al. for the reasons discussed above with respect to claims 4 and 5, respectively, over Namiki et al. taken alone.

Summary

It is submitted that the references cited by the Examiner, taken individually or in combination, do not teach of suggest the features of the present claimed invention. Thus, it is submitted that claims 4, 5, 11-13, 15 and 16 are in a condition suitable for allowance. Reconsideration of the claims and an early Notice of Allowance are earnestly solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: 2/24/03

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CERTIFICATE UNDER 37 CFR 1.8(a)

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on 2/24/2003

STAAS & HALSEY

By: Richard A. Gollhofer

Date: 2/24/03

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please AMEND the claims in accordance with the following:

4. (ONCE AMENDED) An optical transmission system [where] , comprising:

a bi-directional transmission line including a first and second optical transmission lines; and

a plurality of Raman amplifiers [are] positioned on [an optical] the bi-directional transmission line, [and] each of the Raman amplifiers [uses] using a plurality of pump lights [wherein,] to amplify optical signals on both of the first and second optical transmission lines so that when power of a first pump light, having a first wavelength, among the plurality of pump lights drops to at most a predetermined level [or lower] in a first Raman amplifier among [the] said plurality of Raman amplifiers, power of a second pump light having [the first] a second wavelength [or a wavelength that is] substantially [the same as] equal to the first wavelength is raised in [one or some of the plurality of Raman amplifiers other than] both a second Raman amplifier located next to the first Raman amplifier on a first side and a third Raman amplifier located next to the first Raman amplifier on a second side.

5. (ONCE AMENDED) An optical transmission system [where] , comprising:

a bi-directional transmission line including a first and second optical transmission lines; and

a plurality of Raman amplifiers [are] positioned on [an optical] the bi-directional transmission line, [and] each of the Raman amplifiers [uses] using a plurality of pump lights [wherein,] to amplify optical signals on both of the first and second optical transmission lines so that when power of a first pump light, having a first wavelength, among the plurality of pump lights drops to at most a predetermined level [or lower] in a first Raman amplifier among [the] said plurality of Raman amplifiers, power of a second pump light having a wavelength adjacent to the first wavelength is raised in [the first Raman amplifier or another Raman amplifier] both a second Raman amplifier located next to the first Raman amplifier on a first side and a third Raman amplifier located next to the first Raman amplifier on a second side.

11. (ONCE AMENDED) The optical transmission system according to claim 4,

wherein[: the] each optical transmission line accommodates "m" optical fibers[;] , and

wherein each of said Raman amplifiers includes a multiplexer multiplexing "m" pump lights having different wavelengths [are multiplexed in each of the Raman amplifiers, and] to provide a multiplexed pump light [is respectively provided] to each of the "m" optical fibers.

12. (ONCE AMENDED) The optical transmission system according to claim 4,

wherein[: the] each optical transmission line accommodates "m" optical fibers[;] , and

wherein each of the Raman amplifiers comprises a multiplexer having "m" input ports and "m" output ports[;] , each of the "m" input ports receiving a polarization-coupled light, [that is] obtained by polarization-coupling two pump lights, [is input to each of the "m" input ports; and] , the multiplexer multiplexes the polarization-coupled lights input via the "m" input ports, and [respectively provides] providing a multiplexed light to the "m" optical fibers.

13. (ONCE AMENDED) The optical transmission system according to claim 4,

wherein[:] each of the Raman amplifiers comprises a multiplexer multiplexing a plurality of pump lights, and providing a multiplexed pump light to [the] said optical transmission line[;] , and

wherein said optical transmission system uses a plurality of multiplexers [are] selected and arranged so that an average of [characteristics] at least one characteristic of the multiplexers [comprised by] in a predetermined number of Raman amplifiers [becomes] has a predetermined [characteristic every] value in each group of the predetermined number of Raman amplifiers[;] and the power of [a] the pump [light] lights is raised in the predetermined number of Raman amplifiers.

15. (ONCE AMENDED) An optical transmission method with which a plurality of Raman amplifiers are positioned on [an] a bi-directional optical transmission line between a first optical terminal station and a second optical terminal station, [and] each of the Raman amplifiers [uses] using a plurality of pump lights, [wherein] comprising:

determining power of each of the [plurality of] pump lights in the [plurality of] Raman amplifiers [is detected by] at the first optical terminal station;

transmitting, when power of a first pump light, having a first wavelength, among the [plurality of] pump lights drops to at most a predetermined level [or lower] in a first Raman amplifier among the [plurality of] Raman amplifiers, a control signal for raising power of a second pump light having [the first wavelength or] a wavelength [that is] substantially [the same

as] equal to the first wavelength$_1$ [is transmitted] from the first optical terminal station to at least one [or some] of the [plurality of] Raman amplifiers [other than] on each side of the first Raman amplifier; and

adjusting the second pump light [is adjusted] in accordance with the control signal in the at least one [or some] of the [plurality of] Raman amplifiers on each side of the first Raman amplifier.

16. (ONCE AMENDED) An optical transmission method with which a plurality of Raman amplifiers are positioned on [an] a bi-directional optical transmission line between a first optical terminal station and a second optical terminal station, [and] each of the Raman amplifiers [uses] using a plurality of pump lights, [wherein] comprising:

determining power of each of the [plurality of] pump lights in the [plurality of] Raman amplifiers [is detected by] at the first optical terminal station;

transmitting, when power of a first pump light$_1$ having a first wavelength$_1$ among the [plurality of] pump lights drops to at most a predetermined level [or lower] in a first Raman amplifier among the [plurality of] Raman amplifiers, a control signal for raising power of a second pump light having a wavelength adjacent to the first wavelength$_1$ [is transmitted] from the first optical terminal station to the first Raman amplifier; and

adjusting the second pump light [is adjusted] in accordance with the control signal in the first Raman amplifier.